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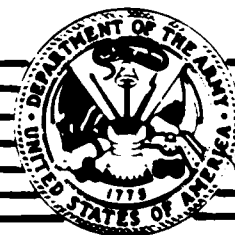
# ARMY STUDY HIGHLIGHTS

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4 December 1989

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MEMORANDUM FOR SEE DISTRIBUTION LIST

SUBJECT: Army Study Highlights

The Army Study Highlights is published annually to acknowledge outstanding efforts of individual analysts and encourage continued excellence in the Army analysis community. This year the panel selected ten quite varied studies which provide an interesting mix.

The studies selected represent examples of efforts that were professionally conducted and are of significance to the Army's missions and goals. Selections were based on an assessment of the principal findings, main assumptions, principal limitations, scope, objectives and approach of each study. Examples of quality analysis have proven to be beneficial to the analysis community. I urge you to make the widest possible distribution of the Army Study Highlights, Volume X.

Because of its continuing benefit, we are again publishing the set of lessons learned from earlier peer review of studies.

We welcome your suggestions. Requests for additional copies of this publication should be directed to Ms. Gloria Brown, of this agency, (AV) 335-2952 / (C) 202/475-2952.

*[Handwritten signature]*  
for

EUGENE P. VISCO, Director  
Model Improvement and Study  
Management Agency  
Office of the Deputy Under Secretary of  
the Army (Operations Research)

SUBJECT: Army Study Highlights

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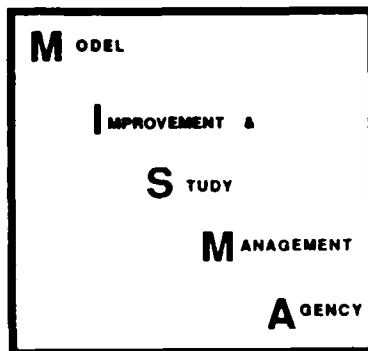
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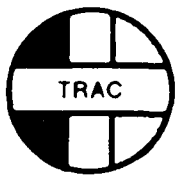
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ADVANCED FIELD ARTILLERY TACTICAL DATA SYSTEM  
COST AND OPERATIONAL EFFECTIVENESS ANALYSIS  
(AFATDS COEA)

STUDY  
GIST

THE PRINCIPAL FINDINGS

- (1) TACFIRE must be replaced
- (2) Lightweight TACFIRE (LTACFIRE), while an interim automation solution for light infantry divisions in the 9th ID configuration, is not a viable replacement for TACFIRE.
- (3) More study of the manual system with the Battery Computer System is needed before a decision not to deploy AFATDS with the Reserve Component units could be made.
- (4) AFATDS is the only reasonable replacement for TACFIRE. AFATDS is also a demonstrably superior system to the 9th ID configuration of LTACFIRE.
- (5) Fielding AFATDS to the Total Army will provide the most cost effective fire support command and control (C2) system for the Army. AFATDS will allow fire support assets to attack the commander's high payoff targets under all expected target processing loads. AFATDS has the ability to use 100 percent of the available fire support assets under all loads. The redundancy of functional capability at fire support operational facilities and redundancy of equipment at those facilities give AFATDS superior continuity of operations (CONOPS) capability. AFATDS is also expected to solve TACFIRE and LTACFIRE training problems.

THE MAIN ASSUMPTIONS

- (1) AFATDS will satisfy Required Operational Capabilities (ROC) and software design specifications.
- (2) Other Army Tactical Command and Control Systems (ATCCS) and programmed Army communications systems will be fielded.

THE PRINCIPAL LIMITATION: Alternative fire support C2 systems could not be compared in a force-on-force combat simulation.

THE SCOPE OF THE STUDY: The study encompassed three candidate fire support automation systems (TACFIRE, LTACFIRE and AFATDS) configured into five Total Army alternatives.

THE STUDY OBJECTIVE: To determine the most cost and operationally effective program for providing fire support C2 to the Total Army through the 1990's.

#### BASIC APPROACH

(1) Using various simulations, an assessment of the capabilities of the three candidate fire support automation systems was made considering Transportability, Mobility, CONOPS, Vulnerability/Survivability, and Reliability/Maintainability.

(2) Assessments of each candidate fire support system was made to determine the capability of each system to provide automated assistance in the performance of the 27 required fire support functions.

(3) To overcome the limitation of not having force-on-force combat simulations that were sensitive to different methods of accomplishing fire support C2, a cost benefit analysis was performed. Costs for the candidate systems and Total Army alternatives were developed. A fire support taxonomy was derived to identify those aspects of fire support C2 that were considered to be direct links to force effectiveness. Pair-wise comparisons of both individual system capabilities and Total Army alternatives' capabilities were made to rank order alternatives.

REASON FOR PERFORMING STUDY: The study updated the 1984 AFATDS COEA to support a Milestone II decision of whether or not to proceed with full-scale development of Block I software for AFATDS.

STUDY IMPACT: Study results helped influence an Army System Acquisition Review Council decision to proceed with full-scale development of Block I software for AFATDS. Prior to the next decision point in FY 92, Block II software development will be underway and limited production of ACCS hardware will be accomplished.

STUDY SPONSOR: Headquarters, Department of the Army, Deputy Chief of Staff for Operations and Plans (DAMO-FD), Washington, DC 20310-5000

PERFORMING ORGANIZATION AND PRINCIPAL AUTHORS: US Army TRADOC Analysis Command, ATRC-WCA, White Sands Missile Range, NM 88002-55-2. Jerry L. Lyman, Charles Lee Kirby, Mark Adams, Robert L. Lillard.

DTIC ACCESSION NUMBER: Assignment Pending. TRAC-WSMR-COEA-6-89.

COMMENTS AND QUESTIONS MAY BE SENT TO: Director, US Army TRADOC Analysis Command, ATTN: ATRC-WGC (Jerry Lyman), White Sands Missile Range, NM 88002-5502. AUTOVON: 258-1800.

#### START AND COMPLETION DATE OF STUDY:

Main Report and Executive Summary: Jan 87 - May 88.  
Addendum to COEA: May 88 - Jul 88.





## AIRLAND BATTLE FUTURE (HEAVY) WARGAME

STUDY  
GIST

### THE PRINCIPAL FINDINGS

- (1) The Airland Battle - Future (Heavy) (ALB-F (HVY)) concept appears robust enough to allow a refocusing of US combat power.
- (2) As played in the game, the ALB-F (HVY) concept is logistically supportable.
- (3) The type and mix of weapon systems in the ALB-F (HVY) concept provides US commanders mobility and flexibility in reacting to a threat. The longer range and effectiveness of surface-to-surface systems allow US defenders to disrupt threat offensive action by engaging first and second echelon forces simultaneously.

### THE MAIN ASSUMPTIONS

- (1) The ALB-F (HVY) concept can be sufficiently examined by focusing only on opposing forces in a limited sector during conflict in Europe.
- (2) Only conventional weapons will be employed.
- (3) The ALB-F (HVY) concept and its doctrinal impact can be sufficiently examined by modeling representative forces.
- (4) The wargame players commanding the opposing forces in the game are sufficient isomorphs for representing the ALB-F (HVY) concept and replicating the decision processes of the actual commanders they represent.

### THE PRINCIPAL LIMITATIONS

- (1) The study evaluated the concept within the context of a specific geographic area and terrain.
- (2) Stylized future forces for both sides were played.
- (3) Obscurants and countermeasures were not portrayed in the model.
- (4) Small unit combat was not explicitly represented.

### THE SCOPE OF THE STUDY

- (1) The study assessed the ALB-F (HVY) concept and its impact on doctrine.
- (2) The wargame examined conventional armed conflict between only Soviet forces and US forces during a Soviet invasion of the Federal Republic of Germany.
- (3) Conflict began with an attack by a portion of three Soviet fronts --facing three US corps--in accordance with the Defense Guidance and Theater Strategic Operation.
- (4) US forces, deployed during the Soviet buildup along the inter-German border (IGB), executed a specific, sponsor-provided concept of the operation the incorporated the ALB-F (HVY) concept.

### THE STUDY OBJECTIVES: This study:

- (1) Obtains insights concerning the effectiveness of projected US ground forces, with supporting air forces, employing the ALB-F (HVY) concept in the Central Region.
- (2) Assesses the feasibility of US forces stopping the Soviet invasion and reestablishing the IGB to its prehostilities state.
- (3) Assesses the feasibility of the ALB-F (HVY) concept in forcing Soviet planners (at Front level) to break off the attack and return to the "planning phase" for future offensive operations.

#### BASIC APPROACH

The basic approach for this study was to conduct a dynamic wargame using the interactive (player directed) Contingency Force Analysis Wargame (CFAW). Information gathered on the movement of the forward line of own troops, losses in selected weapons systems, consumption rates for selected munitions and the flexibility provided US commanders by the ALB-F (HVY) concept would be analyzed to assess the robustness of the concept. Strengths and weaknesses of the concept would be identified and recommendations made to the study sponsor for concept modification or further study.

#### REASONS FOR PERFORMING STUDY

The study was performed to provide the Airland Battle - Future (Heavy) Special Study Group operational insights into the ALB-F (HVY) concept. These insights could then be used to refine the ALB-F (HVY) concept prior to final publication.

#### STUDY IMPACT

(1) The study provided insights into the balance in the combat capabilities of the US force played, the potential impact of countermeasures on the concept, the flexibility of the concept and potential Soviet reactions to the Concept.

(2) The study enriched the concept by providing more information on the potential effect of the concept and lent credibility to its feasibility.

#### STUDY SPONSOR

Director, Airland Battle Future (Heavy) Special Study Group  
Combined Arms Center  
Fort Leavenworth, Kansas

#### PERFORMING ORGANIZATION AND PRINCIPAL AUTHORS

US Army Concepts Analysis Center  
8120 Woodmont Avenue  
Bethesda, MD 20814-2797  
Principal author: Major Michael H. Abreu

DTIC ACCESSION NUMBER: C956613

#### COMMENTS AND QUESTIONS MAY BE SENT TO:

Director  
US Army Concepts Analysis Agency,  
ATTN: CSCA-SPC  
8120 Woodmont Avenue  
Bethesda, MD 20814-2797

#### START AND COMPLETION DATES OF STUDY

January 1989 - May 1989



## ARMOR/ANTIARMOR MASTER PLAN SUPPORTING ANALYSIS

# STUDY GIST

TRAC-F-TR-0480

### THE PRINCIPAL FINDINGS

The methodology developed for the study provided an appropriate way to examine system effectiveness across the battlefield. This combined arms approach, coupled with the sufficiency criteria defining minimum standards for Blue success and Red failure, provided the means to develop system mixes capable of achieving success on the battlefield. A cost effective, balanced force was developed which met the sufficiency criteria without requiring several expensive systems. When additional direct fire systems were introduced into the force, the contributions of all direct fire systems were reduced due to target stealing.

### THE MAIN ASSUMPTIONS

The study will focus on VII Corps' Blue defensive requirements. Developmental systems will be fielded by their first unit equipped (FUE) date. Threat force data and representations are valid as portrayed in the Europe 6.3 scenario. Blue forces will operate according to AirLand Battle (ALB) doctrine.

### THE PRINCIPAL LIMITATIONS

Only one corps-level scenario, Europe 6.3, was available. Second-echelon issues were not addressed because only the first 48 hours of the scenario were simulated. Time and computer system availability limited both the number and length of runs. In the Vector-In-Commander (VIC) model, the direct fire algorithm could not effectively represent either multiple-shot or long-range fire-and-forget capabilities; mine effectiveness was underrepresented; and nuclear and electronic warfare could not be addressed. Multiple-launch rocket system (MLRS) terminal guidance warhead (TGW) and Army tactical missile system (ATACMS) data were not available.

### THE SCOPE OF THE STUDY

The study determines, from a combined arms perspective, the preferred mix of weapon systems in a 1996 corps. The VIC model, with the Europe 6.3 scenario, and the Combined Arms and Support Task Force Evaluation Model (CASTFOREM), with high resolution scenarios HRS 12 and 3 (mod), were used to examine the contribution of individual weapon systems, compare their effectiveness, and determine their mix. A review of completed and ongoing studies was conducted.

### THE STUDY OBJECTIVES

This study determines the mix of weapon systems preferred for armor and antiarmor force planning and identifies which of the many systems being planned or developed could be eliminated and still allow the U.S. Army to accomplish its war-fighting objectives.

#### THE BASIC APPROACH

Review the results of studies ongoing and completed and incorporate pertinent results. Determine the sufficiency criteria. Analyze weapon system performance using the VIC and CASTFOREM models to identify effective and ineffective systems. Develop alternative forces which could meet the sufficiency criteria. Identify the most cost-efficient alternative. Test its ability to meet the sufficiency criteria and conduct preliminary logistics and personnel impact analyses.

#### THE REASON FOR PERFORMING THE STUDY

The study was performed to support the Armor/Antiarmor Master Plan by providing a quantifiable analysis that prioritized weapon systems and produced a system mix based upon war-fighting requirements.

#### STUDY IMPACT

The study provided the sponsor with an affordable mix of systems which would meet the war-fighting requirements of the 1996 timeframe. The methodology developed for examining system effectiveness from a combined arms perspective was adopted by the DA-sponsored Armor/Antiarmor Special Task Force and has been presented as an example of combined arms analysis to numerous Department of Defense and allied personnel. Papers have been accepted for presentation at both the 1989 Military Operations Research Symposium (MORS) and the 1989 Army Operations Research Symposium (AORS).

#### THE STUDY SPONSOR

Commander  
Combined Arms Combat Developments Activity  
ATTN: ATZL-CAM (Materiel Integration Directorate)  
Ft. Leavenworth, KS 66027-5300

#### THE STUDY PROPONENT

Headquarters, TRADOC  
United States Army Training & Doctrine Command  
Ft. Monroe, VA 23651-5000

#### THE ANALYSIS AGENCY AND PRINCIPAL AUTHORS

Director  
TRADOC Analysis Command-FLVN  
ATTN: ATRC-FSA Systems Analysis Directorate  
Ft. Leavenworth, KS 66027-5220  
Authors: LTC Michael Farrell; MAJ Dave Cammons; John Abshier;  
Susan Solick; Cindy Sullivan; Scott Cox; Arley Cordonier

DTIC ACCESSION NUMBER: 314942

#### COMMENTS AND QUESTIONS MAY BE SENT TO:

Director  
TRAC-FLVN  
ATTN: ATRC-FSA (Susan D. Solick)  
Fort Leavenworth, Kansas 66027-5220  
AUTOVON: 552-5481

START AND COMPLETE DATES OF STUDY: Feb 88 - Sep 88.

## Chemical Downwind Hazard Modeling Study

### PRINCIPAL FINDINGS

(1) This study developed a three-dimensional prognostic hydrodynamic and Monte-Carlo kernel transport and diffusion system which can be used on a desk-top computer.

(2) The model has the capability to forecast wind and turbulence distribution to produce realistic transport and diffusion of airborne materials.

(3) Accurate predictions can be done to address hazards extending from 100 to 150 km.

(4) Current model can account for long transport times, changing meteorological conditions, agent depletion effects over time, and terrain features.

### MAIN ASSUMPTIONS

(1) Present D2 model used for predicting the transport and diffusion of chemical agents accidentally released to the atmosphere does not satisfy Army needs for an accurate prediction of dosage levels and casualty estimations.

(2) Downwind hazard assessments can be improved.

### PRINCIPAL LIMITATIONS

Limited funds were available for tracer studies; therefore, only one chemical storage site was evaluated.

### SCOPE OF THE STUDY

(1) Developed a list of criteria for comparing the capabilities of the model.

(2) Reviewed and assessed current efforts to model atmospheric transport and diffusion of liquid and gaseous compounds.

(3) Obtained information on the unique characteristics of the storage sites which could impact on the transport and diffusion of materials from the site.

(4) Developed a model that could predict the no-deaths and no-effects levels on a real-time basis that can account for site-specific terrain and ground cover effects.

(5) Performed a preliminary and final validation through the use of field tests using tracers and agent simulators.

### STUDY OBJECTIVE

To investigate the state-of-the-art technology and models used to predict the transport and diffusion of toxic materials downwind.

### BASIC APPROACH

(1) The study team met with various Government agencies to confirm study objectives and methodology.

(2) Literature search, site interviews, and inspection of current operations were done at the Army chemical storage sites.

(3) During model development, a data interface system and the following modules were developed: wind field module,

diffusion module, source and deposition module, and receptor module.

(4) Identification and selection of a computer system was determined.

(5) Evaluation and validation of the model was done at Tooele Army Depot, Utah.

#### REASONS FOR PERFORMING STUDY

(1) Recently, more stringent criteria for downwind hazard effects have been imposed. This requires longer travel distances and times from a release for sufficient dilution to be achieved.

(2) An accurate real-time prediction of agent release is needed for the on-site commander at each storage sites.

(3) Existing emergency response systems use diagnostic models that do not have a wind forecasting capability. They use a Gaussian puff formulation that cannot treat the effects of wind shear on hazardous transport.

(4) Army needs a reliable method of assessing impact of accidental toxic agent releases on the general population to ensure public safety.

#### STUDY IMPACT

(1) The recommended hazard prediction system will give the on-site commander immediate identification of the no-deaths and no-effects dosage zones for toxic agents accidentally released.

(2) The study will provide the Army grounds for protection against legal actions reference population safety.

#### STUDY SPONSOR

Commander

US Army Nuclear and Chemical Agency

7500 Backlick Road Bldg 2073

Springfield, VA 22150

Sponsors: Mr. James Walters and CPT Debra Thedford

#### PERFORMING ORGANIZATION AND PRINCIPAL AUTHORS

Los Alamos National Laboratory

Los Alamos, New Mexico 87545

Principal authors: Ted Yamada, Michael Williams, and Greg Stone

DTIC ACCESSION NUMBER: This study was recently completed and will be filed in DTIC.

#### COMMENTS AND QUESTIONS MAY BE SENT TO:

Los Alamos National Laboratory

ATTN: Ted Yamada

Los Alamos, New Mexico 87545

(505) 667-8353

#### START AND COMPLETION DATES OF STUDY:

June 1986 - April 1989

STUDY TITLE

DAMS Configurations Study. DAMS is an acronym for Division Ammunition Management System.

THE PRINCIPAL FINDINGS

- (1) Six alternative ammunition distribution concepts were evaluated. The most successful (alternative 6) consisted of (a) Company/Battery Convoys, (b) Combat Loading of Ammunition, (c) Menu Packs, (d) Committed Stocks, (e) Combat Loaded ATP Line-Haul Trailers, (f) ATP Support to all divisional units, and (g) ASP support for non-divisional units.
- (2) Any concept which decreased reliance on TO&E vehicles would improve the system due to the limited number of TO&E trucks.
- (3) Alternative 6 (described above) provided ATP and ASP capabilities that were not overtaxed due to limited organic vehicles in the combat units.
- (4) Average convoy delay time waiting for returning trucks was reduced by almost 3 hours by alternative 6 over the present doctrine (pre-MOADS).
- (5) Reliance on the ASP should be reduced as much as possible to curtail travel times, i.e., maximum support to all units from the ATP.

THE MAIN ASSUMPTIONS

- (1) The Division Ammunition Office MIS (DAOMIS)\* was operational.
- (2) Communications links for successful operation of DAOMIS were operational.
- (3) LOGMARS was operational.
- (4) Unit Level Computers (ULCs) and TACCS were operational.
- (5) DAOMIS functioned equally well with each alternative.
- (6) As a consequence of the above systems, the Division Ammunition Officer (DAO) had accurate and timely information concerning the status of stocks on hand, stocks due in and unit requirements upon which to base requisitioning and distribution decisions for each of the alternatives.
- (7) Requisitioning and distribution decisions were correct and timely.
- (8) No redistribution of ammunition between divisional units was required.

\*NOTE: DAOMIS is now the SAAS-DAO. The O&O Plan was approved November 1988.

THE PRINCIPAL LIMITATIONS

- (1) Due to the magnitude of the study to evaluate alternative concepts, the number of units and the number of ammunition types (DODICs) were limited.
- (2) Standard Scenario Europe V force structure was modeled.
- (3) The makeup of Combat Configured Loads (CCLs) is still controversial and a set of CCLs were designed for this study. Changes in the configuration of CCLs will cause some perturbations in results.

THE SCOPE OF THE STUDY

- (1) The study concentrates on the third component of DAMS: improving the physical distribution of ammunition. The DAMS operational concept is described in Appendix F to TRADOC Pam 525-49 (17 January 1986).
- (2) Several combinatorial elements were reduced into six alternatives which varied from current doctrine (pre-MOADS) through various configurations into alternative 6, which is a close approximation to MOADS.
- (3) Develop/reconfigure the Ammunition Point Simulation (APS) model and the Ammunition Resupply Model (ARM) into an IBM-PC/AT compatible configuration.
- (4) Determine which alternative offers the greatest potential benefit to user units with the least additional resources required for implementation.
- (5) Achieve a balance within the overall framework of DAMS to best meet user needs while providing the highest possible ammunition supply productivity.

#### STUDY OBJECTIVES. This study;

- (1) Investigates six alternative physical distribution procedures for ammunition supply to the battlefield.
- (2) Concentrates on determining how ammunition loads can be configured to meet needs of combat units while posing the fewest negative impacts on the ability of the system to respond/support high demand rates.
- (3) Analyzes the tradeoffs required to satisfy user needs while maximizing supply unit productivity within the DAMS operational concept.

#### BASIC APPROACH

The first phase of the study required model enhancements to eliminate the cumbersome data input requirements and turnaround delays encountered with the present APS and ARM models. Without this achievement, the magnitude of the study could not be accomplished. This portion resulted in an improved model, now called the DAMS Model that can provide up to 30 days of simulated combat within a 24 hour turnaround. During the next phase after achieving the model results, comparative analyses were performed to evaluate several MOEs, including (a) greatest reduction in overall transportation requirement, (b) greatest reduction in overall workload, and (c) greatest satisfaction of ammunition demand. Benefits were associated with meeting user demands while costs were associated with additional ammunition supply resource requirements. Analysis of transportation requirements were addressed and recommendations were provided for future considerations. Two significant recommendations are; (1) that all units be serviced by ATPs rather than sending non-divisional units to the ASP, and (2) that 5-ton trucks be replaced with 10-ton HEMTTs in mechanized infantry, aviation, and air defense artillery units.

#### REASON FOR PERFORMING STUDY

The study was performed to provide the sponsor with an assessment of the most advantageous ammunition supply process. Among the various competing resources, e.g., manpower, materiel handling equipment, trucks, etc., it is necessary to know where the "choke" points are in the flow of ammunition from the Corps Storage Area (CSA) forward to the using units, and how to meet peak demands with a reasonable assurance that the supply system can deliver.

#### STUDY IMPACT

- (1) The study enabled the sponsor to move ahead confidently with the new MOADS concept. The concept is approved and published in the current FM 9-6 (1989).
- (2) The study raises serious concern over the availability and quantity of transportation assets for ammunition distribution.

#### STUDY SPONSOR: Commandant

U.S. Army Ordnance Missile and Munitions Center and School  
Redstone Arsenal, AL 35897-6000

#### PERFORMING ORGANIZATION AND PRINCIPAL AUTHORS

Directorate of Combat Developments	Strategic Financial Planning Systems, Inc.
Test and Eval Division, USAOMMCS	6601 Little River Turnpike
Redstone Arsenal, AL 35897-6500	Alexandria, VA 22312
Authors: J.M. Phipps, J.T. Newell, & L. Jones (OMMCS); F.C. McQuigg (SFPSI)	

#### DTIC ACCESSION NUMBER: TBD

#### COMMENTS AND QUESTIONS MAY BE SENT TO:

##### Commandant

U.S. Army Ordnance Missile and Munitions Center and School  
ATTN: ATSK-CT (James T. Newell) AUTOVON 746-9406  
Redstone Arsenal, AL 35897-6500

#### START AND COMPLETION DATES OF STUDY

October 1985 - February 1988: Final report consists of four (4) volumes



## EVALUATING THE COMBAT PAYOFF OF ALTERNATIVE LOGISTICS STRUCTURES FOR HIGH-TECHNOLOGY SUBSYSTEMS

### The Principal Findings

(1) The study demonstrated a methodology for exploring the impact of simultaneous changes in transportation, repair, and inventory resource levels on the combat availability of major weapons systems.

(2) The research concluded that the wartime usage of high-technology (e.g., electronic) systems results in highly variable demand rates for repair resources. The variability is high enough that the Army must pursue organizational and policy changes that increase the ability of logistics systems to respond quickly.

(3) The Army can achieve this responsiveness by changing the configuration of three elements in its logistics structure, which will dramatically increase the availability of combat-ready tanks.

- Move the location of electronic repair to higher echelons.
- Increase the availability of electronic test equipment.
- Improve distribution methods and depot management.

(4) In one configuration, test equipment and component repair are moved to the Main Support Battalion, additional sets of test equipment and operators are procured for the repair facility, and a Blackhawk utility helicopter and an Information System are included to improve distribution. This configuration results in the availability, on average, of 350 more tanks in an armored Corps than in the base case, at a cost of about \$20 million. The Army would have to spend a minimum of \$150 million to achieve this same benefit by buying additional stock.

### The Main Assumptions

(1) The study relies on peacetime and field exercise data that were collected at activity rates below expected wartime activity rates. The study assumes that the linear increase in mean demands with activity observed across these data also holds for wartime rates.

(2) The study assumes that a 120-day wartime scenario for one Corps is sufficient to observe resource effects.

(3) CONUS Depots can fill inventory requisitions, but they are prevented from doing so for up to the first 30 days of combat because of inter-theater transportation priority conflicts.

(4) Direct Support test equipment is exposed to damage from artillery fires only. (Adding aviation attacks is expected to strengthen the findings.)

### The Principal Limitations

The study used a scenario derived from the Concepts Analysis Agency (CAA) simulation for a European theater conflict. We believe the variation of timing of brigade engagements in the CAA Simulation reflects the variability expected of a Corps engagement in any major theater. To the degree that other scenarios would show greater variability in engaged units, it would strengthen our results.

### The Scope of the Study

- (1) Uses the M-1 Tank to reflect the support challenges of major high-technology systems.
- (2) Estimates the peacetime and wartime variability in demand for repair resources of the M-1's high-technology subsystems.
- (3) Develops specific responsive support alternatives.
- (4) Estimates the change in tank availability in a representative Corps from each alternative and compares each alternative to the current logistics structure, which relies heavily on stocking spare parts.

### The Study Objectives

- (1) The study determines how new logistics structures can be devised that can adapt and react quickly to sudden bursts of demand for repair.
- (2) The study uses innovative methodologies to judge the value of the new logistics structures in terms of costs and a combat-related criterion -- weapon system availability.

### Basic Approach

Our procedure for the study was to: (1) survey logistics operations for the M-1; (2) collect data on the reparable components of the tank and its support system; (3) analyze and structure the data in an innovative multi-echelon model of the support process (Dyna-METRIC); (4) identify alternatives to be explored; and (5) evaluate those alternatives.

### Reasons for Performing the Study

Since the early 1980s, including high-technology systems has resulted in decreasing repair flexibility while costs for those systems and the Class IX spares have increased. As a result, all Army echelons need better assessment tools to evaluate how maintenance and support resources affect combat capability. These evaluations will allow tradeoffs to improve combat effectiveness while increasing responsiveness to unpredictable demands for support resources.

### Study Impact

- (1) Results have influenced doctrinal changes in FM 100-10 in terms of using theater aviation resources.
- (2) The study methods, along with data on the AH-64 Apache helicopter, have led to plans for a major field test of these concepts for the Apache.
- (3) The techniques demonstrated led to our study technology being transferred to the TRADOC Analysis Command where the techniques were used in a Cost and Effective Analysis (COEA) for the Integrated Family of Test Equipment (IFTE) requirements.

### Study Sponsor

Commanding General, TRADOC Logistics Center

### Performing Organization and Principal Authors

RAND Corporation

Authors: M.B. Berman, D.W. McIver, M.L. Robbins, J.F. Schank

### DTIC Accession Number

RAND Report Number R-3673-A, "Evaluating the Combat Payoff of Alternative Logistics Structures for High-Technology Subsystems", M. B. Berman, et al, October 1988 (DTIC number requested but not yet assigned)

### Comments and Questions may be sent to:


RAND Corporation

POC: M.B. Berman, Readiness and Sustainability Program Director

Phone: (213) 393-0411

### Start and Completion Dates of Study:

OCT 1986 to FEB 1988

	<p align="center"><b>INTEGRATED AIR DEFENSE ASSESSMENT STUDY (IADA)</b></p>	<p align="center"><b>STUDY GIST</b></p>
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### THE PRINCIPAL FINDINGS

(1) An evaluation was made of an alternative employment concept for PATRIOT and HAWK missile systems based on a scheme of defense in depth (weighted coverage) rather than uniform area coverage. Sensitivity analysis was performed for cases involving unavailability of defensive counterair aircraft; larger raid sizes; severe electronics CM; and effects of terrain masking.

(2) Insights were gained as to the impact on air defense effectiveness of the following factors:

- (a) Operational availability rates
- (b) Distance from the FLOT
- (c) Antiradiation missile decoys
- (d) Degraded command, control, and communications
- (e) Selective engagement capability

### THE MAIN ASSUMPTIONS

(1) Only "in-place" units and supplies would be available at the start of conflict. Warning time (approximately 48 hours) will be sufficient for units to deploy to wartime positions.

(2) There will be no attrition to Blue air defense assets by ground action; no attrition to Red or Blue aircraft on the ground; conventional weapons only.

(3) Forces will be those available in 1992.

(4) No attrition to transiting Red aircraft by forward-based short range air defense systems will be considered.

(5) The threat is as per US Army Intelligence and Threat Analysis Center (ITAC) document, Air Threat to Central Europe, 1983-2000 and Beyond (ATCE-2000).

### THE SCOPE OF THE STUDY

The scope of the study was to evaluate different PATRIOT and HAWK employment options against the initial Soviet "corridor-busting" air raids attempting to strike rear airbases in Central Region of Europe.

### THE STUDY OBJECTIVES

(1) Evaluate the effectiveness of an alternative employment concept for PATRIOT and HAWK designed for defense in depth rather than uniform area coverage.

(2) Provide insights into operational impact of varying selected factors affecting air defense performance.

### THE BASIC APPROACH

The basic approach was to simulate mass air raids on different attack routes through the Central Region using the COMO Integrated Air Defense (IAD) Model.

### THE REASON FOR PERFORMING THE STUDY

The reason for performing the study was to assist the Commanding General, 32d Army Air Defense Command (32d AADCOM), in evaluating an alternative employment concept for the PATRIOT and HAWK missile systems designed for defense in depth (weighted coverage) rather than uniform area coverage.

### STUDY IMPACT

The IADA Study was a rigorous analysis of a complex operational situation under a large number of conditions and situations. The needed answers were provided in a timely manner to the Commanding General, 32d AADCOM so as to allow him to make better decisions based on objective analysis.

### THE STUDY SPONSOR

Commanding General  
32d Army Air Defense Command  
ATTN: AETL-GC-PL  
APO NY 09175

### PERFORMING ORGANIZATION AND PRINCIPAL AUTHORS

US Army Concepts Analysis Agency  
8120 Woodmont Avenue  
Bethesda, MD 20814-2797  
Principal authors: LTC James N. Carpenter, Pamela J. Roberts, Diane L. Buescher, MAJ Wayne J. Van Gorden, Thomas A. Rose, Richard W. Lennox, Jr., and Tanya E. Peltz, Force Systems Directorate, US Army Concepts Analysis Agency.

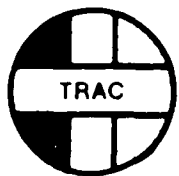
DTIC ACCESSION NUMBER: C044864

### COMMENTS AND QUESTIONS MAY BE SENT TO:

US Army Concepts Analysis Agency  
8120 Woodmont Avenue  
Bethesda, MD 20814-2797  
ATTN: CSCA-FSC (Mr. Thomas A. Rose)  
AUTOVON: 295-0270

### START AND COMPLETION DATES OF STUDY

April 1988 to November 1988



INTERMEDIATE FORWARD TEST EQUIPMENT  
COST AND OPERATIONAL EFFECTIVENESS ANALYSIS  
(IFTE COEA)

STUDY  
GIST

THE PRINCIPAL FINDINGS

(1) The utilization of Automatic Test Equipment (ATE) at three levels (depot and intermediate general and direct support) is the preferred placement strategy.

(2) Both system specific (SS) and general purpose (GP) ATE (IFTE) can perform the test, measurement, and diagnostic (TMD) function, maintaining supported systems at a 90 percent level of operational availability.

(3) GP ATE at three levels, alternative 3A, was the least costly alternative at low level demand and was the preferred alternative. Alternative 3A, at higher demand levels, can perform as well as alternative 3B, the use of SS ATE at three levels, provided additional ATE are included. Alternative 3A provides the flexibility to meet a variable demand.

(4) The largest cost factor for all GP ATE alternatives was the sustainment costs while production costs were the largest cost factor for SS ATE alternatives. Approximated Army-wide costs developed for all alternatives did not change the rankings of the alternatives.

(5) The three level placement alternatives (3A and 3B) had the most positive impact on the current combat service support (CSS) structure. The one level, depot only alternatives had the greatest negative impact on the current CSS structure.

(6) Alternative 3A was the preferred alternative based on the analysis of cost, CSS impacts and flexibility to meet a variable demand.

THE MAIN ASSUMPTIONS

(1) The systems are represented in the analysis by their respective line replaceable units (LRU) and the LRU data used represents the best available data.

(2) The workload derived from the study scenario is representative of a corps and echelon above corps (EAC) slice workload in the 1990 timeframe.

(3) The operational availability of supported weapon systems will be that specified by DA standard.

THE PRINCIPAL LIMITATIONS

(1) Both GP and SS ATE had the same inherent TMD capability.

(2) The maintenance process modeled was a three level abstraction from the Army's more complex process.

(3) Costs of SS ATE and test program sets (TPS) development were estimates based on past projections from the materiel developers.

THE SCOPE OF THE STUDY: Theater Army ATE deployment strategy.

THE STUDY OBJECTIVES

- (1) Determine the operational effectiveness of ATE placement with respect to three alternative placement strategies.
- (2) Determine and compare the cost of each study alternative with respect to the use of IFTE or SS ATE.
- (3) Determine the impact on the CSS system of each alternative in terms of both logistics and training subsystems.
- (4) Address those issues raised by the GAO with respect to the development of IFTE not covered in objectives 1-3 above.

BASIC APPROACH

- (1) Develop an electronic maintenance workload generated by a Europe VI scenario.
- (2) Examine that workload to determine the primary systems contributing the preponderance of LRU failures.
- (3) Model the maintenance process using the derived workload as a driver.
- (4) Determine the cost and CSS impact of each alternative.

REASON FOR PERFORMING THE STUDY: The study was performed to support a milestone III Army in-process review (IPR) on IFTE.

STUDY IMPACT: The study provided to decision makers quantitative analysis at the milestone III IPR on the implementation of GP ATE.

STUDY SPONSOR: Commander, U.S. Army Training and Doctrine Command, Office of Deputy chief of Staff for combat Developments (ODCSCD), ATTN: ATCD-SL (MAJ Sisco), Fort Monroe, VA 23651

PERFORMING ORGANIZATION AND PRINCIPAL AUTHOR: Director, U.S. Army TRADOC Analysis Command, ATTN: ATRC-WDC, White Sands Missile Range, NM 88002-5502. Mr. John L. Noble

DTIC ACCESSION NUMBER: B132298

COMMENTS AND QUESTIONS MAY BE SENT TO: Director, U.S. Army TRADOC Analysis Command, ATTN: ATRC-WDC (Mr. Noble), White Sands Missile Range, NM 88002-5502.

START AND COMPLETION DATES OF STUDY: February 1987 to January 1989.



# OCONUS UNIT ROTATIONS

## STUDY GIST

### BACKGROUND

Unit rotations and dependents overseas continue to generate Congressional interest as a means of reducing costs associated with forward deployed forces. Previous studies concluded that rotating units overseas in a temporary duty status (TDY) is more expensive than permanent change of station (PCS) rotations and has a negative impact on readiness. Because of the intense interest in this subject, the Army's Chief of Staff directed that the issue be reexamined in detail. The work of previous studies was of limited value because there was no way to retrieve the data base used to support the findings.

### PRINCIPAL FINDINGS

The analytical models developed for this study provided the first comprehensive means of determining the relative costs involved in rotating personnel between CONUS and OCONUS locations in both a TDY and PCS status. Every effort was made to use the most current cost data available. All data and computations are provided so that cost data can be reviewed and updated as necessary. Key findings include:

- Of the units modeled, TDY costs exceeded PCS costs for all battalions except the Attack Helicopter Battalion. This fluctuation was caused by the high officer to enlisted ratio and the relative difference in entitlements.
- A 3:1 CONUS to OCONUS rotation ratio provides 18 months of stability in CONUS; this is considered the minimum stability level for a sustained rotation scheme.
- There are 17 battalion size rotation schemes possible utilizing a 3:1 ratio; less than 10% of USAREUR's force would be affected if all schemes were activated.
- Unit rotations do not save money unless all dependents are removed from the installation and the family support infrastructure is closed.



- Most family support costs transfer to CONUS; real savings are minimal.

## **MAIN ASSUMPTIONS**

- That OCONUS dining facilities are adequate to support rotation schemes.
- That sufficient accommodations are available for soldiers requiring quarters on the economy.
- That special air mission rates apply and that planes return with passengers.
- That 75% of all E7s and above and 50% of all other soldiers are married.
- That on post housing is not available to support family members returning to CONUS.
- That CONUS family support activities are adequate to support the increase in "home basing" dependents should an unaccompanied rotation scheme be activated.

## **PRINCIPAL LIMITATION**

Although there was no particular limitation involved, a concern still exists. That is, there is no way of knowing the actual impact a long term rotation scheme will have on personnel, morale, or readiness. Although this does not affect the study results, it could impact on any future decision to activate such a program.

## **SCOPE OF THE STUDY**

Because Congressional interest has been focused on our forward deployed forces in Europe, the study centered on a European rotation scenario. However, the models were constructed so that any rotation scenario could be "played" simply by inserting the applicable cost data and force structure.

## **STUDY OBJECTIVES**

The study objective was to determine whether six-month unaccompanied unit rotations to Europe were a means of reducing the cost

of forward deployed ground forces. The outcome of the study provides Army decision makers with a better understanding of the cost involved with unit rotations and provides a foundation for responding to Congressional inquiries.

### **BASIC APPROACH**

The study approach was fourfold and centered on the following sub-issues of six-month unaccompanied rotations:

- To determine what CONUS to OCONUS ratio is required to support a prolonged rotation scheme.
- To determine what rotation schemes are possible.
- To determine and compare TDY versus PCS costs.
- To determine the cost implications of activating an unaccompanied rotation scheme and returning dependents to CONUS.

### **REASONS FOR PERFORMING THE STUDY**

To validate the assumptions of previous studies and provide a more in depth, quantifiable report of the costs and rotation scheme possibilities.

### **STUDY IMPACT**

The study was used to respond during Congressional testimony and will assist in future inquiries to dispel the misconception that unaccompanied unit rotations to Europe are cheaper than PCS moves.

### **STUDY SPONSOR**

Headquarters, Department of the Army  
Office of the Deputy Chief of Staff for Operations and Plans  
Washington, D.C. 20310

### **PERFORMING ORGANIZATION AND PRINCIPAL AUTHOR**

Headquarters, Department of the Army  
ATTN: DAMO-SSW  
Washington, D.C. 20310

Principal Author: LTC John T. Senter

**COMMENTS AND QUESTIONS MAY BE SENT TO**

Headquarters, Department of the Army  
ATTN: DAMO-SSW (COL Harper)  
Washington, D.C. 20310

Autovon: 227-497

**DTIC**

Study has been forwarded to the Defense Technical Information Center for document processing. No DTIC number has been assigned to date.

**START AND COMPLETION DATES OF STUDY**

November 1988 - July 1989



PERSPECTIVES OF THE  
FEDERAL REPUBLIC OF GERMANY:  
PAST, PRESENT AND FUTURE

STUDY  
GIST

THE PRINCIPAL FINDINGS:

- (1) Citizens in the contemporary Federal Republic of Germany are no longer convinced of the imminence of a Soviet threat.
- (2) There is a growing defense weariness in West Germany.
- (3) A newer generation that did not experience World War II or the reconstruction has different perceptions of U.S. presence and defense priorities.
- (4) In the future, Germany is likely to be more independent on defense issues and will likely insist on a lower defense profile by NATO forces.
- (5) The United States should encourage a more independent, pro-western Germany.
- (6) Political changes are rapidly occurring in Germany; the United States should plan ahead for a different Germany and a different Europe.

THE MAIN ASSUMPTIONS:

- (1) That the Federal Republic of Germany is a keystone to U.S. defense efforts in Europe.
- (2) That, despite changes in the attitudes of FRG's populace, the country remains by-and large pro-western, pro-U.S.
- (3) That it is in the U.S. interest to encourage a strong and pro-U.S. Federal Republic of Germany.

THE PRINCIPAL LIMITATIONS:

- (1) The study was limited to the Federal Republic of Germany (FRG); East Germany was intentionally excluded.
- (2) All research was done either at the USAWC Library or in Washington, D.C. No additional research trips were taken to Europe (author was there repeatedly 1986-1988).
- (3) Cutoff on data for this report was April 1988; events after that date have not been factored in.

THE SCOPE OF THE STUDY:

- (1) Reviews basic political, social, and economic events that have shaped modern Germany.
- (2) Assesses current political, social, and defense attitudes held by the populace in the FRG and their political parties.
- (3) Based on identified trends, develops three scenarios which project what the FRG may look like in the future.
- (4) Develops conclusions on these scenarios.

THE STUDY OBJECTIVES:

- (1) Clearly identify German attitudes on (a) United States, (b) Soviet Union, (c) defense issues.
- (2) Discuss divergent views between Germans and the Americans on East-West relations.
- (3) Show effect these trends would have on U.S.-German relations if they continue.
- (4) Enable Army leadership to plan for continued good relations with a more independent Germany.

BASIC APPROACH:

The basic approach for this study was to survey all available literature regarding German attitudes on defense issues, the United States, and the Soviet Union. Once this material was compiled and analyzed, a narrative was developed indicating: (1) background of German attitudes, (2) party and popular attitudes on defense issues, East-West relations, (3) trends resulting from these issues, and (4) three possible scenarios of a future Germany if these trends endure. Author's conclusions then followed.

REASONS FOR PERFORMING STUDY:

The study was performed to provide the Army with a basic understanding of current German attitudes on East-West relations and defense issues and thus to encourage Army leadership to plan ahead for the rapidly changing German political scene.

STUDY IMPACT:

The study was favorably reviewed by DAMO-SSP and Major General Sewall, Director of Strategy, Plans and Policy. Following DAMO-SS and DAMO-SSP recommendations, the study was briefed to the Army Policy Council where possible changes in Army policies were discussed.

STUDY SPONSOR:

Director  
Strategic Studies Institute  
U.S. Army War College  
Carlisle Barracks, PA 17013-5050

PERFORMING ORGANIZATION AND PRINCIPAL AUTHORS:

Strategic Studies Institute  
U.S. Army War College  
Carlisle Barracks, PA 17013-5050

Principal Author: Dr. Samuel J. Newland

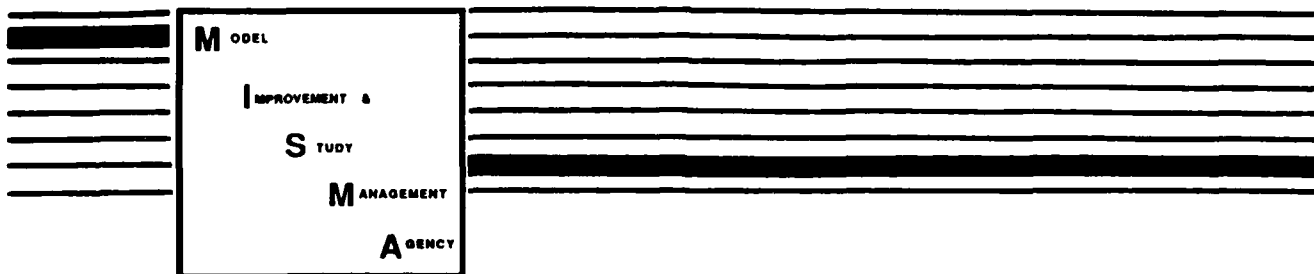
DTIC ACCESSION NUMBER: A201340

COMMENTS AND QUESTIONS MAY BE SENT TO:

Director, Strategic Studies Institute  
ATTN: Dr. Samuel J. Newland  
U.S. Army War College  
Carlisle Barracks, PA 17013-5050  
AUTOVON 242-3121

START AND COMPLETION DATES OF STUDY:

September 1987 - September 1988



## LESSONS LEARNED FROM RECENT EXTERNAL PEER REVIEWS

## LESSONS LEARNED FROM RECENT EXTERNAL PEER REVIEWS

Devin Bent, PhD, Consultant to SPMA

### INTRODUCTION

Since 1982 the Deputy Under Secretary of the Army for Operations Research has sponsored external peer review of selected Army studies. Fourteen peer reviews have been completed through 1987. The lessons learned from the first five were compiled in 1984 and published in Army Highlights, Volume V, 1984. The lessons learned from the nine most recent peer reviews are presented below. Comments on the lessons learned are welcome and should be addressed to the Department of the Army, Study Program Management Agency, ATTN: SFUS-SPM, Washington, DC 20310.

### CAVEAT

It is an unfortunate consequence of a lessons learned report that it seems to accentuate the negative. Thus it should be noted that several studies received very positive reviews, that every study made a contribution to the understanding of Army problems, and that all the studies shared certain strengths. For example, in no instance did the review panel doubt the objectivity of the study team. It must also be stressed that this compilation of lessons learned is derived from a small sample.

1. Literature Search: It is a characteristic of science that it is cumulative: it varies, builds on or even challenges what has come before. The cumulative nature of science requires that each study team familiarize itself with the previous body of work. It is therefore disturbing that the most frequently advanced criticism of the studies reviewed was either the absence of a literature search or a narrowly focused literature search that ignored relevant literature. This is not simply a pedantic criticism; in two cases the review team attributed other specific weaknesses in the study to the inadequate literature search. For example, an inadequate methodology was linked to unfamiliarity with the relevant methodological literature.

2. Presentation: An adequate presentation is also required if research is to be cumulative. While the study team may convey their findings to the sponsor through briefings and informal communication, the larger study community will become familiar with the study only through the written report. Inadequate presentation was one of the weaknesses stressed in the first lessons learned report (1984), and though mentioned less often, is also a characteristic of this set of reviews. However, there may be a hidden problem with presentation, since one of the two peer review teams that interviewed the study director found that significant matters were played down or omitted from the report. The peer review panel recommended that study teams be provided "more time and training to write clear, concise, and complete reports so that the full value of analytic efforts can be provided to the Army and not limited

to those who participated in the effort."

3. Cost Analysis: In the previous lessons learned report it was found that "Studies that involved cost analysis were judged to be shallow in this respect, although in both cases cost was a key factor." The finding of this report is similar. There were only two of the recent studies in which cost analysis was judged to be important by the peer review team and in both cases no cost analysis was presented.

4. Address Objectives: It would seem to be a basic requirement that the study address the defined objectives. However, in several cases the study either fails to address the objectives or addresses a related, but significantly limited set of objectives. In one instance, the review panel noted "significant omissions" in the study and questioned the "effective freedom of analysts to get into all facets of the problem." Because of the omissions, the objectives could not be adequately addressed.

5. Sensitivity Analysis: The previous lessons learned report found "serious problems of validity of results because of small samples, lack of sensitivity analysis and failure to estimate confidence intervals." The findings of this report are similar. Small sample size is mentioned in only two of the peer reviews; however, six of the nine peer reviews either note the total absence of sensitivity analysis or suggest that sensitivity analysis would be appropriate.

6. Measures of Effectiveness: Measures of effectiveness were also discussed in the previous lessons learned report. The problem is not as prevalent in this second set of reviews, but two studies do have significant weaknesses in this respect. In one case, no measures of effectiveness are developed and in the other, criteria are listed, but "not applied to compare alternatives or otherwise derive results." By way of contrast, another peer review team specifically commends the measures of effectiveness which are "defined in constructible, arithmetic terms."

7. Integration of Substudies: The previous report noted an "incomplete integration of substudies into a coherent analysis" in three of five studies. No mention is made of this problem in the nine peer reviews examined for this report.

#### CLOSING

It seems appropriate to publish the lessons learned from external peer reviews in the Army Study Highlights. Peer reviews and Army Study Highlights share the objective of improving the quality of Army studies. While the lessons learned from peer reviews do seem to emphasize the negative, the studies highlighted in this publication exemplify the best in Army studies.